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Through the Display Glass

(with apologies to Lewis Carroll)

What plants can flower year-round and thrive without water or sunshine? To find out, look at some of the many habitat groups our museum has to offer.

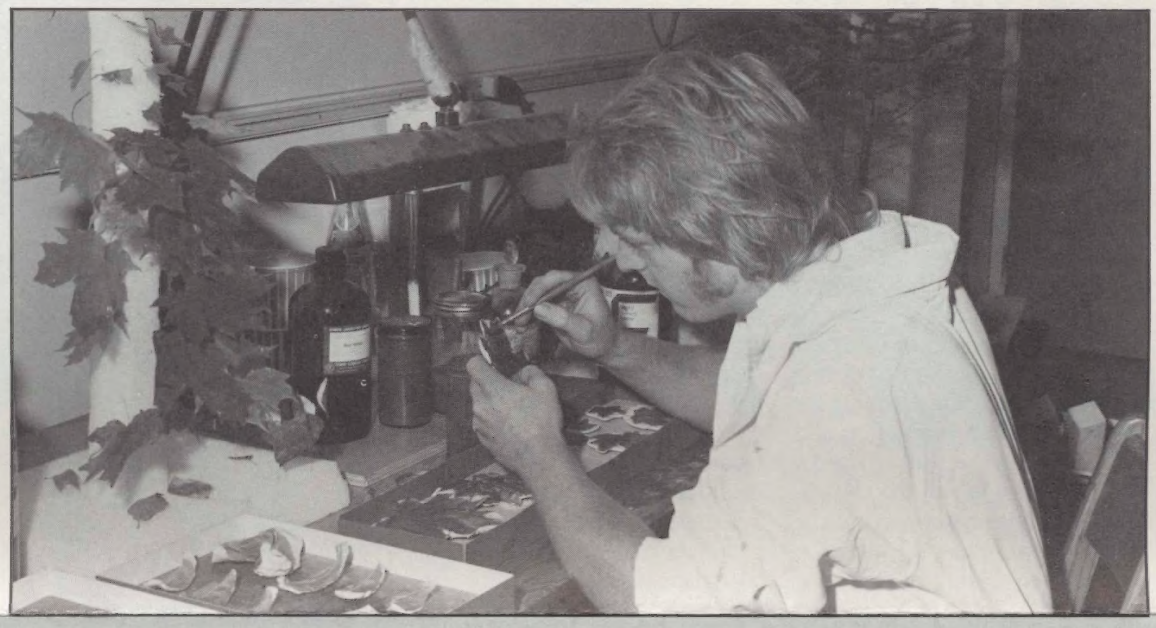
For instance, no matter what the season is outside our massive stone walls, a visit to the *Birds in Canada* gallery reveals the yellow heads of glacier lilies basking in a warm, western, spring morning while a wary White-tailed Ptarmigan picks its way through delicate patches of full-bloomed white heather and newly emerged mountain avens. But seasons do change here: in the fall, high on a Lake Erie escarpment, a Broad-winged Hawk sits poised on a dead tree branch while, nearby, two Monarch butterflies about to begin their winter migration flutter around yellowing milkweed plants.

The habitat groups that contain these plants, birds and insects, as well as an incredible variety of other lifeforms, could themselves be considered as forming the habitat of a rare breed of animal known as the display preparator. Actually, this term refers to a diverse and multitalented assembly of individuals who combine art and science in creating the illusion of perpetual, suspended life within a given time and place.

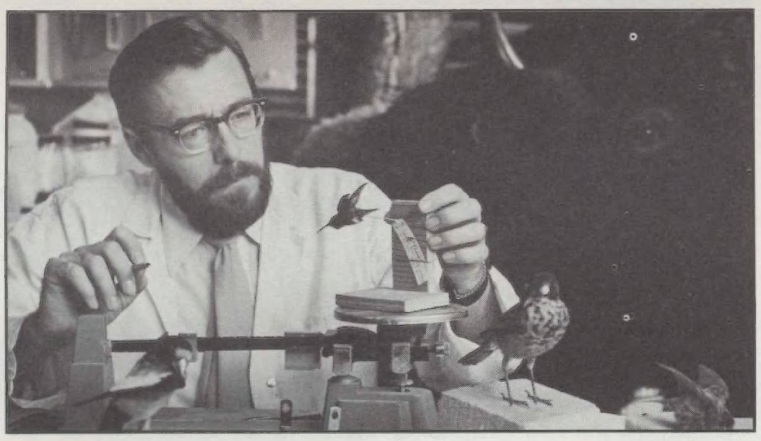
The process of developing a habitat group, also called a diorama, begins years before the first public viewing and involves many facets of the Museum community. Scientists whose particular research fields will be presented in the exhibit are consulted continuously: from specimen collection to last-minute alterations, every fin, fur, feather and flower must receive scientific approval in order to ensure the educational value and accuracy of the display. A planning and design team helps to establish the contents, graphics and surroundings to maximize the interpretive impact and provide an entertaining yet enlightening environment for the visitor.

Once the scientific and thematic criteria for the exhibit are determined, a field trip is organized to collect specimens and data from the appropriate locale. The final selection of the specific foreground and background components is made on location based upon the preliminary concepts. The background artist prepares notes and rudimentary field sketches which, when applied to the final product, will help to capture not only the physical aspects of the region but also more intangible qualities such as mood.

Meanwhile, the foreground preparator and a scientist identify native plant species required for the display, make extensive anatomy and distribution notes, and take numerous photographs, as each specimen is collected. Plaster leaf and flower moulds are made of plants that cannot be preserved; back at the display lab, these will provide negative casts from which durable plastic positives can be obtained. Plants that can be preserved are either shipped back alive or are temporarily treated until their final processing in the display lab.



Creating the illusion of perpetual life: David Spence prepares a branch in full leaf for a mounted bird specimen.



Terry Morgan prepares a Ruby-throated Hummingbird. Amazingly lifelike mounts result from careful observation in the field combined with years of experience and training.

Another of nature's suspended moments: Dall's sheep in Kluane National Park, Yukon Territory. The "boulders" in the foreground are fibreglass reproductions cast from rubber moulds.

When animal specimens are to be collected, a taxidermist accompanies the field party and prepares critical references such as photographs, colour notes and casts of anatomical details. Treated specimens are then carefully transported to the display lab, where they will be processed into amazingly lifelike mounts using a wide range of preservation and reconstruction techniques.

Several weeks on rocky mountain slopes or on a windswept tundra may be required during these early stages, but this is only a brief prelude to what is involved in painstakingly reconstructing the habitat upon return to the display lab. Once back, the background artist usually begins by mapping out and enlarging his field sketches on a fibreglass diorama shell, which looks somewhat like the upturned bow end of a roundbottomed boat. Details of plant and animal communities are added to the distinguishing landmarks, and then the shell is painted to match colour notes taken at the site. Depending on the size of the shell and the intricacies of composition, this process can take from three to ten months.

At the same time, a foreground is prepared, which exactly fits the floor plan of the shell. A composite wood and foam base is contoured to correspond with gradients depicted in the painting, and is usually sloped upward at the back to increase the illusion of depth and perspective. Over this is laid a ground cover typical of the area, such as humus, leaf litter, rocks, earth or sand. Occasionally, the entire foreground is made up of massive boulders, cliff faces or mountain ledges, such as in the *Mammals in Canada* gallery's Dall's sheep group. Since it would be impractical (or impossible) to use this kind of original material, lightweight fibreglass reproductions are cast from rubber moulds made during the field trip.

Plants are made in various ways, and the process often involves the careful moulding, cutting, painting and assembly of tiny pieces of plastic, paper, wire, wax and adhesives. A large foreground can take up to two years to complete, but its components may last a lifetime.

Finally, the meticulously prepared plants and animals are arranged as they would be found in the wild. With the addition of appropriate lighting, the union of foreground to background is complete, and another of nature's suspended moments is ready for the public.

As you tour the National Museum of Natural Sciences, you may notice different techniques used in the preparation of these displays, many of which are old friends that have been with us for more than 20 years. Gradually, each one is being upgraded, using improved methods, in our continuing commitment to provide our visitors with some of the finest exhibits of their kind in the world.

David Spence
Technical Operations Division

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EDITORIAL

The Consequences of Old Information?

Major advances in understanding the origins and relationships between animals, plants and minerals took place in the 1700s and 1800s. Encyclopaedic works catalogued, named and described huge numbers of new species, although tens of thousands remain to be discovered. In the mid 1800s, Charles Darwin provided a framework on which the classification of living organisms could be based — evolution. During that time and into the mid 1900s, major museums of natural history developed from collections, often in association with universities. These collections represent the world's key to life on the planet. Museum scientists continue to collect, describe, name and classify new species and to deduce the relationships of origin amongst living organisms. From their work, such sciences as ecology, physiology and cell biology are derived. Without the database contained within the collections, it would not be possible for other sciences to operate. Thus the sciences of taxonomy (naming of species) and systematics (deriving their relationships and classifying them on that basis) are the underpinnings of all other sciences.

But universities are now seriously underfunded, and have been divesting themselves of collections, thereby decreasing interest in museum research; some universities no longer offer courses that have even one plant or animal specimen in them. Also, Canada has no policy governing or supporting natural history research in museums other than the National Museums of Canada. The many natural history museums that carry on this type of research do so through provincial or local support. Indeed, although collections such as those in our Botany Division constitute vast reservoirs of knowledge, Canada officially provides no institution with the mandate to inventory and preserve the knowledge of the diversity and distribution of *all* life forms in the country. In most countries the National Museum is given that mandate; especially to preserve the holotypes (that unique specimen that for all time serves as a reference for the definition of the species) of new species or higher taxa. Because Canada has no such policies, there are no regulations to prevent the export of holotypes of new Canadian species, genera or other taxa from the country.

The consequences of these problems are already becoming apparent; consulting companies, federal agencies and a host of miscellaneous users of old information are producing increasingly faulty predictions about resource management and assessments of impacts as a result of development projects, sometimes with disastrous results to the natural environment, and sometimes with needlessly stringent protection measures or cancellations of projects.

Alan R. Emery
Director

BIOME

Editor-in-Chief:
Nick Bélanger

Acknowledgements:
Bonnie Livingstone
Annie J. Ollivier

Art Direction:
Design Division, NMNS

Graphic Design:
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Illustrations:
Charles Douglas
Sandra Taylor

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Comments and questions should be directed to:

BIOME
National Museum of Natural Sciences
Ottawa, Ontario
K1A 0M8

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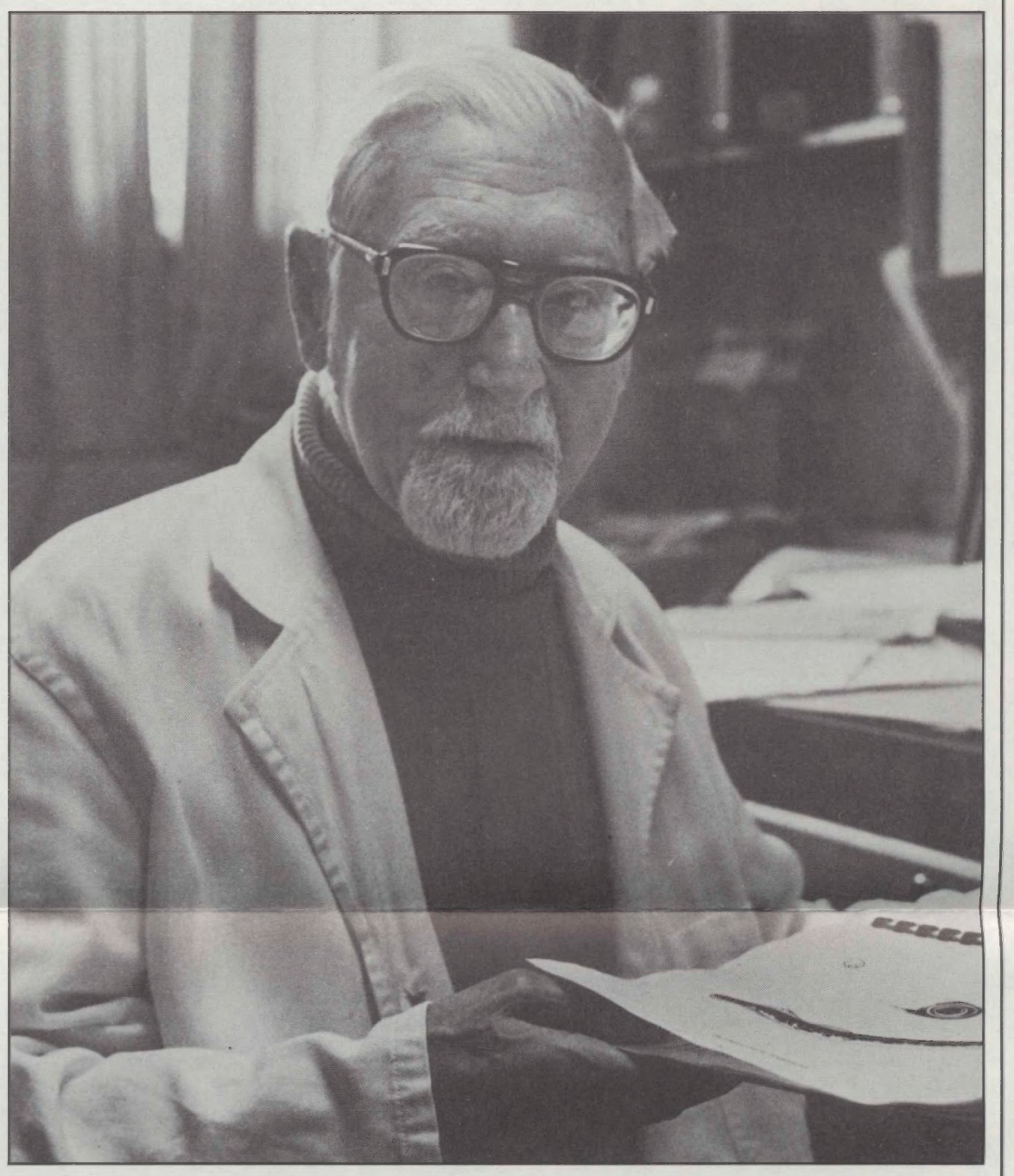
Vadim D. Vladykov (1898-1986)



Professor Vadim D. Vladykov at age 85. Photograph taken by his long-time collaborator, friend and fellow countryman, Mr. George Ben-Tchavtchavadze.

Editor's note: Professor Vadim D. Vladykov, a Research Associate of the Museum for 13 years, died at the age of 87 on January 14, 1986. Professor Vladykov has had a major impact on ichthyology and is particularly well known for his work on lampreys and salmonids. The following is adapted from an article by Claude B. Renaud, a colleague of Professor Vladykov at both the Museum and the University of Ottawa, which appeared in COPEIA 1986, Number 2:

Vadim Dimitrij Vladykov, known affectionately to many as V.D.V., was born in Khar'kov, the Ukraine, on March 18, 1898. He liked to say that his zodiacal sign Pisces predestined him to a career in ichthyology.

In 1917 he entered the Faculty of Natural Sciences of the University of Khar'kov, but interrupted his studies in 1919 to join the White Army during the Russian civil war. After the civil war, he went to Charles University in Prague, graduating in 1925 with the degree of *Rerum Naturalium Doctor*. He later studied bacteriology and serology at the Institut Pasteur in Paris and worked at the Muséum national d'histoire naturelle. As a result of his work there, he was elected correspondant du Muséum and awarded the medal of the Société centrale de l'agriculture et de la pêche.

He emigrated to Canada in 1930. Between 1930 and 1942, he worked for the Biological Board of Canada (now Fisheries and Oceans Canada) as a fisheries biologist for the State of Maryland, became the first ichthyologist to teach at the University of Maryland, and was professor of ichthyology at the University of Montreal. From 1943 to 1958, he was directeur du Laboratoire de biologie du Département des pêcheries du Québec: during this period, he founded two biological stations and helped in the planning of the Aquarium de Québec. In 1958 he came to the University of Ottawa as a full professor, and in 1973 was named Professor Emeritus. Already a member of numerous learned societies, he was elected a Fellow of the Royal Society of Canada in 1963, and in 1973 was given the honorary position of Research Associate at the National Museum of Natural Sciences.

Professor Vladykov was an energetic, dynamic and humorous man who instilled his enthusiasm for ichthyology in countless numbers of co-workers. Between 1965 and 1968, at an age when most people have slowed down their pace, he went on three scientific cruises to the Caribbean Sea. In 1977, when he was 79, he made a worldwide trip alone: first to Japan, followed by crossing the USSR on the trans-Siberian express, and then travelling to Bulgaria, Greece and Belgium. He spoke several languages, all of them tinted with a strong Russian accent, but when frustrated or annoyed would harangue students and colleagues alike in a bewildering mixture of Russian, French and English!

He wrote 209 scientific publications throughout his career: although the vast majority deal with fishes, he also wrote ten publications on whales, five on diseases in plants, two each on insects, crustaceans and amphibians, and one each on hydrography and arachnids. At the time of his death, despite the confinement of a wheelchair, he was actively working on two manuscripts. Professor Vladykov was a true naturalist.

Older than Methuselah

A fine old specimen of bristlecone pine in the White Mountains of California (Photo courtesy of Laboratory of Tree-Ring Research, University of Arizona).

Longevity, the age of living organisms, is a topic that is often obscured by deceit and exaggeration. The Bible tells us that Methuselah lived to be 969 years old (*Genesis* 5:27). According to the Guinness Book of Records, the oldest human lived an authenticated 120 years. Whether 120 years or 969 years, these ages pale beside those of the world's longest lived organisms — plants.

At elevations between 2100 and 3400 m in the White Mountains of east-central California, small, yet persistent, groves of trees manage to exist in what can only be described as a very inhospitable environment. These trees, the bristlecone pines (*Pinus aristata* and *Pinus longaeva*), root in rock-strewn ground, where nothing else can grow, in almost unimaginably cold temperatures accompanied by extremely high winds.

Interest in these trees began in 1953 when scientists at the University of Arizona's Laboratory of Tree-Ring Research embarked on a study of the tree-rings of timberline trees, searching for evidence of climatic change (see *BIOME* Vol. 5:1). Almost by accident, the scientists were drawn to the bristlecone pines and discovered to their amazement that these stunted (rarely more than 9 m in height), nearly dead pines, seemingly holding on to life against all odds, were older than any previously dated living tree. In fact, a count of annual growth rings in one specimen showed that the tree was more than 4600 years old!

This tree, later named "Methuselah," sprouted from seed about 2600 years *before* the birth of Christ, at the time the Assyrian kings ruled Babylon. By the time the great pyramids of Egypt were built, it was already 1400 years old!

Why bristlecone pines live so long is still somewhat of a mystery, but their extremely slow growth (up to 1500 annual growth-rings may be present in only a 40 cm core), forming a very dense, hard wood, protects them against physical damage. The oldest specimens contain high concentrations of resin, which is believed to ward off decay.

Since the discovery of their remarkable age, the bristlecone pines have been the subject of research on climatic change. The University of Arizona continues to lead the way in finding clues hidden within the tree-rings, which provide a year-by-year interpretation of environmental conditions for the southwestern part of the United States. By comparing cores from several trees, living and dead, scientists were able to piece together a "tree-ring history" spanning the last 7100 years. Using this tree-ring chronology and computer-based techniques, trees over 1600 km away could be compared and tied into the bristlecone sequence, thus expanding knowledge of the region's past climate. So living trees help to date dead, decayed ones that may be 9000 or more years old!

Scientific discoveries made through the study of the bristlecone pines have brought these trees to public attention. Their long history and aesthetic appeal (they have become a prime subject of artists and photographers) have drawn increasingly large numbers of visitors to the White Mountain bristlecone groves. Unfortunately, increased human activity may endanger the continued existence of the oldest living organisms in the world.

Dr. David M. Jarzen
Paleobiology Division

The Activity Corner: A Coldwater Aquarium

In Canada, the trend is to save energy and to turn our thermostats down in the winter. So it is not surprising that many aquarists are discovering the coldwater aquarium. Eliminating the heating system reduces the initial cost, and there is less evaporation. On the other hand, coldwater animals must still be protected from a sudden change in temperature, since this is likely to cause shock, which is commonly followed by disease. Cooling systems are too expensive for most hobbyists, and condensation on the outer wall of the aquarium obscures the view. The solution is to match the water temperature to the room temperature, and to choose the animals and plants accordingly.

An aquarium at room temperature is maintained in the same way as a tropical tank. If balanced, it does not need constant attention. An aquarist needs only to provide food, to remove excess vegetation and debris, and to scrape growth off the glass.

Each aquarium is a miniature aquatic community: the interactions of the inhabitants provide continuous entertainment for the enthusiast. Consider whether you want to have a setup similar to a lake, river or pond, and try to duplicate such an environment.

A perfectly clean tank is not ideal for aquatic animals. Disintegrated leaves and debris on the bottom provide nutrients for microscopic life: bacteria break down wastes and provide nutrients to the plants, which, in return, provide oxygen to the animals.

Grow plenty of plants: they are essential to the diet of most animals, and offer hiding places for young and less aggressive fish. Floating plants such as duck weed (*Lemna minor*) and bladder wort (*Utricularia vulgaris*) provide shade for light-intolerant plants. Two fast growers, *Elodea* and *Cabomba*, thrive in cold water.

Check your animals for compatibility and whether they need companions of their own kind.

Also, some animals may not adapt to the home aquarium. You should consult your local pet shop, aquarium society, or museum expert, or read articles about your pets' requirements.

Fish species are rich in variety. In Japan and Hawaii, where fish keeping is a tradition, koi (*Carrassius carrassius*) and goldfish (*Carrassius auratus*) are kept in ornate garden ponds. Recreational koi societies and breeders compete for awards for their aquatic pets. In Canada, hobbyists have been discovering the satisfaction of keeping coldwater fish only recently. The American Goldfish Association promotes the care and breeding of this species in North America.

Other fish that adapt well to the home aquarium have originated in areas that undergo extreme environmental fluctuations, such as in flooded streams and ditches. The Chinese white cloud mountain minnow (*Tanichthys albonubes*), labyrinths such as the Siamese fighting fish (*Beta splendens*), the paradise fish (*Macropodus opercularis*), the black tetra (*Gymnocorymbus ternetzi*), the clown loach (*Botia macracantha*) and the zebra fish (*Brachydanio rerio*) thrive at house temperatures.

Snails are useful in the removal of wastes. The European snail (*Planorbarius corneus*) is available in grey or gorgeous red varieties. The Japanese snail (*Cipangopaludina chinensis*) bears live young. Choose the species carefully, since some snails multiply rapidly and require thinning out.

There are other suitable animals, such as salamanders, newts, frogs, turtles, insects, and crayfish. One goal is to successfully rear offspring within the confines of the aquarium and to observe mating and parental activities. Animals as diverse as the American crayfish (*Orconectes virilis*) and the eastern newt (*Notophthalmus viridescens*) stimulate our curiosity and fascination. This is what makes having an aquarium worthwhile!

Jacqueline Madill
Zoology Division

A Half-million Vascular Plants!

The Museum's Botany Division has a new floral centrepiece: dried purple flowers pressed flat and glued to a sheet of paper. This may not be a visually spectacular centrepiece, but it is very special, since it is also the half-millionth specimen in the vascular plant collection of the National Herbarium.

The flowers are those of an alpine milkvetch (*Astragalus alpinus* L.) from western Melville Island in the Northwest Territories, about 1000 km north of the Arctic Circle. Dr. Sylvia Edlund of the Geological Survey of Canada collected the plant in 1985, within a few kilometres of the northern limit of its distribution. This specimen is one of several thousand that Dr. Edlund has recently donated to the Museum to document the botanical research that she has been conducting in the High Arctic since 1971.

It is not surprising that the half-millionth vascular plant specimen had its roots in the Arctic. Botanists at the Museum have had a long-standing interest in the flora of the Canadian North, and the National Herbarium currently houses one of the world's most valuable collections of arctic plants. The selection of this northern specimen as the half-millionth accordingly reaffirms both the Museum's interest in the Arctic and its co-operation with other government departments in the study of Canadian flora.

But once in the collection, the specimen became just one of the crowd: in addition to the half-million vascular plants (the flowering plants, conifers, ferns, horsetails and clubmosses), the National Herbarium also houses bryophytes (mosses, liverworts and hornworts), algae (freshwater and saltwater species, including diatoms and "seaweeds") and lichens. The bryophyte, algae and lichen collections total another quarter-million plants!

An herbarium is best thought of as a botanical reference library that features dried and pressed plants instead of books. As such, the National Herbarium houses a vast reservoir of knowledge. An international botanical resource such as this attracts scientists from around the world; visitors from New Zealand and China are among those who have come here to study.

Plants within the National Herbarium come from various sources. Many are collected by Museum staff, others are donated, a small number are purchased, and some arrive as exchanges from other museums and universities. They include North American plants from the early 1800s to the present day, and document the changing flora of Canada over a long period of time. In fact, the National Herbarium has been the source of much of what we know about the past and present vegetation of Canada, and will serve as a baseline to trace changes as they occur in the future. The half-millionth vascular plant marks a milestone in the continuing growth of Canada's national plant collections.

Carol Campbell
Botany Division

Dr. Sylvia Edlund from the Geological Survey of Canada (left) and NMNS volunteer Marthanna Allan, with the half-millionth vascular plant being prepared for the collections of the National Herbarium of Canada.

The pronghorn

In the soft glow of a prairie evening, a pronghorn antelope suddenly appears beside the road. Gracefully, and without apparent effort, it races alongside a car, seeming to delight in the sheer exuberance of the run. Then, as swiftly as it appeared, it veers off to one side, and within seconds is swallowed up by the prairie grasslands.

The pronghorn (*Antilocapra americana*), phantom of the prairie, is the fleetest of North American mammals. In short bursts, it may reach 96 km per hour, and can normally run distances up to 6 km at speeds of 56-64 km per hour. Although it is called an antelope, it is not closely related to the true antelopes of Africa and Asia. It is the only surviving member of a family of horned ungulates, native to North America, that roamed the continent in the Miocene, Pliocene and Pleistocene periods. The forked horns that give this animal its name actually consist of hollow outer horns, which are shed each fall, and permanent unbranched bony cores that fit inside the hollow sheaths. It is the only mammal with horns (*not* antlers) that are shed annually.

The pronghorn is a small trim animal, about 90 cm high at the shoulder, with long pointed ears, large dark eyes, slim delicate-looking legs, and small pointed hooves. Its voice is a soft blow that sounds like *cha-oo*. Males are larger than females, and can be distinguished by their horns and dark face. Females are generally hornless, although they sometimes have short unbranched spikes. The underparts are white, and the back is tan with a short black mane. Distinctive markings include two broad white bands across the throat, and a large creamy white patch or rosette on the rump. When a pronghorn is disturbed, the long hairs on this rump patch become erect and open out like a flag, a warning signal that other pronghorns can see for several kilometres on the open prairie.

Pronghorns normally travel together in small herds. Adult bucks establish territories with bands of does, yearlings and kids in the spring, although there are also bachelor groups consisting of young and old males that did not establish territories. This territorial set-up continues from March to October: mating takes place in late summer, and does give birth (usually to twins) the following May or June in an isolated small valley.

Newborn pronghorn kids have wavy dappled grey coats and enormous dewy eyes. Although they can outrun a man a few days after birth, they are hidden by the doe for the first three weeks, twins usually some distance apart from each other. When the kids are older, does often co-operate in a kind of babysitting arrangement, where one will assume responsibility for guarding a group of kids while the others feed or visit a watering hole. Pronghorn kids are weaned after four months but continue to follow their mother during the first winter.

Most pronghorns live about four and a half years. They graze primarily on forbs (herbaceous broad-leaved plants), such as clover and alfalfa, and browse on shrubs such as sagebrush and other woody browse plants. With their keen eyes, they can see objects up to 6.5 km away. They are also extremely curious, a trait that worked to the advantage of early hunters, who used to lure them into rifle range by waving shirts or other objects in the air.

In Canada, pronghorns are now restricted to southern Alberta and Saskatchewan. They were once as plentiful as bison on the North American prairies, and ranged further north than today, but have suffered from over-hunting and the encroachment of civilization. Although they can leap considerable distances, they refuse to jump over even low fences and will instead crawl under or through a fence. Woven wire fences stop them completely, and during severe winters, herds moving south may become trapped and starve to death or fall victim to coyotes, their chief predators.

Carol Thiessen
Public Services Division

JEOL: State of the Art

Last March, the Museum acquired a "state of the art" electron microprobe, the JEOL Superprobe 733, purchased with a special $600,000. grant from Treasury Board.

If there was an instrument capable of differentiating between 100 brands of vanilla ice cream, this would be it. But the brands that the microprobe is "tasting" at the Museum are somewhat harder to sink your teeth into, since they are minerals. Scott Ercit, manager of the Mineral Sciences Division's microprobe laboratory, says that this high-tech gem can rapidly distinguish one mineral species from another, such as in the amphibole group, which has over 50 distinct yet frustratingly similar species.

The microprobe will greatly facilitate the cataloguing of the division's vast mineral collection as well as the identification of new mineral species. While the division's reputation in this area is already excellent, now averaging five percent of all new mineral discoveries worldwide, it could become even better with the acquisition of the microprobe. Without it, characterizing a new mineral can sometimes take years, as was the case for Moydite, a recently identified mineral from west Quebec's Gatineau Hills that was named for the division's Curator Emeritus, Louis Moyd.

Up until this year, the division primarily used an X-ray diffraction unit to study the structure of atoms in mineral samples. With the microprobe, Ercit and his colleagues will also be able to almost instantaneously analyze the chemical composition of minerals — what elements are there and how much of each of these elements. "We've known half the picture for a number of years, but now we can collect all the data" Ercit notes. "To properly describe any mineral species, we needed both tools."

The JEOL 733 has three interconnected parts: the central electron column with a light microscope and X-ray detectors, the main electronics console with a viewing screen, and a microcomputer with colour screen and printer. A high voltage (5-35 kilovolts) is passed across a filament inside the column, creating an electron beam that is focussed on a mineral sample, causing it to emit X-rays. The energies or wavelengths of the X-rays indicate what elements are contained in the sample, their intensities, how much of each element is present. The microprobe can identify up to 81 elements simultaneously and report on their proportions in the sample.

The microprobe is also capable of operating like a scanning electron microscope (SEM). The upper magnification limit of the microprobe is close to 100,000 times, which means that objects as small as one ten thousandth of a millimetre can be resolved.

This new equipment promises to make life a lot easier not just for mineralogists, but also for other Museum researchers: Dr. Don McAllister of the Zoology Division plans to study fish scales with the JEOL 733.

In spite (or perhaps because) of all its high-tech wizardry, the microprobe requires some pampering. One of its X-ray detectors survives on a steady diet of liquid nitrogen to keep its temperature several hundred degrees below zero degree Celsius. Without this, it would be unstable because it is made up of a material that decomposes at room temperature. "It has to be fed regularly like a baby, but there's never a mess to clean up."

It also seems that the microprobe gets rather finicky in a damp environment. "What we need now is a dehumidifier."

Jennifer Plater